

Application S/N: 10/099,623  
Atty Docket No. 1014-15

Date of Response: June 17, 2005

### REMARKS

The Examiner required a corrected Oath/declaration specifying the citizenship of one of the inventors. The Examiner also objected to the Drawings because monitoring unit 22 noted in applicants' specification was not shown in FIG. 12. The Examiner also objected to the Abstract as exceeding 150 words, and to various minor informalities in the specification. Finally, the Examiner rejected claims 54 and 55 under 35 U.S.C. 103(a) as being allegedly unpatentable over Epworth et al. (GB2188719).

#### General Remarks regarding Various Objections

In response to Examiner's requirements and objections noted above, applicants have provided:

- a corrected declaration showing the citizenship of all inventors (as an attachment to this paper);
- a replacement sheet for FIG. 12, as well as a sheet showing the changes (addition of monitoring unit 22); and
- various amendments to the specification and abstract to address all of the informalities noted by the Examiner on pages 3 and 4 of the January 10, 2005 Office Action.

In light of the above responses, applicants respectfully request that the various objections be withdrawn.

(continued on next page)

“look” of Epworth fiber with the “helical” grating structures or “ribs” (Epworth FIGs. 1, 2a, 2c, 2d, and 3a) along with the usage of terms “helix” and “double helix” by Epworth throughout the specification, may appear on the surface to suggest similarity to applicants’ invention. However, in fact, application of the various methodologies taught by Epworth cannot produce the chiral fiber gratings of applicants’ invention. This is due to the

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fact that any fiber structure produced using any of the methods taught or suggested by Epworth can never be a chiral structure, and thus will not have the advantageous optical and other properties thereof.

Applicants respectfully suggest that the Examiner's use of the term "chiral" with respect to the methodology disclosed by Epworth throughout the Office Action is in error. Thus, before explaining the significant differences between Epworth's methodologies and those of applicants' invention, it would be helpful to provide a brief overview of chiral structures.

"Chiral" materials are not symmetrical on a molecular level – that is molecules of chiral materials are not identical to their mirror images. Film-based chiral materials, such as cholesteric liquid crystals (hereinafter "CLCs"), have multiple molecular layers where molecules in the different layers are oriented on average at a slight angle relative to molecules in other layers. Molecules in consecutive layers are rotated slightly relative to those in the preceding layer. Thus, the average direction of the molecules, known as a "director", rotates helically throughout the cholesteric material. A pitch of a cholesteric material is defined as a thickness of the material in which the director rotates a full 360 degrees. In the past, CLCs were the primary type of chiral materials achievable in practice.

The crux of Applicants' invention is a novel methodology for fabricating a new form of a fiber grating that is created by configuring an optical fiber to have chiral properties – in essence substantially mimicking a chiral structure, such as a cholesteric liquid crystal structure, in that as one moves along the chiral fiber's longitudinal axis, the cross-sectional structure of the chiral fiber appears oriented along a different angle, eventually coming around through a full 360 degree rotation. Thus, moving along a chiral fiber, the cross

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section structure of the fiber rotates by an angle  $A$  for every distance  $D$  moved, with  $A$  and  $D$  depending on the type of chiral structure (bragg grating, chirped, apodized, etc.).

To achieve the desired chiral properties, thereby creating a fiber grating, applicants impose a refractive index modulation on an optical fiber in accordance with one or more refractive index profiles, each profile being defined by the relationship between a helical pitch and a period of chiral refractive index modulation imposed on the fiber core. For example, in one refractive index profile, the helical pitch of the fiber core is equal to twice the core's period, while in another refractive index profile, the helical pitch of the fiber core is equal to the core's period.

Thus, the method of applicants invention requires that the refractive modulation itself, is helical or double helical, along the longitudinal axis of a fiber, whereas, in stark contrast to applicants' invention, Epworth uses various sources of external pressure applied to helical or double helical external ribs or other elements (i.e. physical mechanisms) that transform external pressure into periodic deformation of the fiber to produce a conventional fiber grating. The refractive index modulation of such a structure is simply periodic (corresponding to deformations imposed on the fiber) without any longitudinal symmetry. When moving along such a fiber, there is no change in the structure cross-section with respect to various angles.

Because a chiral structure requires helical or double helical refractive index modulation along its length, application of pressure to a chiral structure would destroy its necessary longitudinal symmetry. Thus, Epworth does not teach disclose, or suggest applicants' invention – fabrication of a novel chiral fiber grating having a chiral structure resulting from refractive index modulation along an optical fiber core, defined by a specific relationship between the structure's helical pitch and the structure's period. In fact, Epworth

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teaches away from applicants' invention by requiring application of external pressure to deformation producing elements on the outer surface of the Epworth fiber workpiece.

Nevertheless, applicants have amended independent claim 54, and dependent claim 55 to further clarify that the refractive index modulation being imposed on the optical fiber work piece is chiral in configuration. These amendments contain no new matter and are fully supported by Applicants' specification and drawings.

Applicants thus respectfully submit that the 35 USC 103(a) rejection of claims 54 and 55 be withdrawn.

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### CONCLUSION

Applicants believe that in light of the foregoing remarks, independent claim 54 is in condition for allowance. Because claim 55 is in proper dependent form and depend from allowable independent claim 54, claim 55 is also allowable. Applicants thus respectfully request that the Examiner withdraw the rejection of claims 54 and 55 and ask that the Examiner pass the application to issue. If there are any questions, the Examiner is urged to contact Applicants' attorney at the below-noted telephone number.

Respectfully submitted,

By



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**AMENDMENTS TO THE DRAWINGS:**

The attached sheet of drawings includes changes to Figure 12. This sheet replaces the original sheet of Figure 12. In Figure 12, previously omitted monitoring unit 22 has been added.

Attachments: Replacement Sheet, and Annotated Sheet Showing Changes

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Annotated Sheet Showing Changes

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FIG. 12

